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Training Maintenance Troops: A Study of Factors Affecting Airman Performance in a Learning Environment

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This report presents the findings of a recent study at the Port Hueneme Naval Station in CA, home of the technical school of Air Force Vehicle Maintenance. The results focus on three specific areas; student learning preferences, individual factors characterizing student performance, and a comparison of alternate training aids. The results indicate that the majority of maintenance troops seem to prefer learning through the kinesthetic method and kinesthetic learners appear to show the most improvement on course exams after training on the equipment.

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1.0 SUMMARY

Training troops to carry out a mission while honoring the United State Air Force (USAF) core values of integrity first, service before self, and excellence in all we do is the top priority of military leaders and trainers. Vehicle maintenance is especially important; one minor malfunction could cause multiple injuries and deaths. Vehicle maintainers are thus trained in grueling learning environments and follow arduous regulations to ensure the utmost adherence to standards. This report presents the findings of a recent study at the Port Hueneme Naval Station in CA, home of the technical school of Air Force Vehicle Maintenance. The results focus on three specific areas; student learning preferences, individual factors characterizing student performance, and a comparison of alternate training aids. The results indicate that the majority of maintenance troops seem to prefer learning through the kinesthetic method and kinesthetic learners appear to show the most improvement on course exams after training on the equipment. Several other factors appear to be related to course performance as well, including mechanical Armed Services Vocational Aptitude Battery (ASVAB) scores and age. In addition, an analysis of an advanced computerized technical training aid failed to show improvement in student performance.

2.0 INTRODUCTION

Training students to reach their potential and go beyond their abilities should be at the forefront of a leader's motivation and goals. This is true in any arena, high schools, undergraduate institutions, graduate schools, and the military. This concept is especially important in today's military training schools. Enlisted troops are increasingly given greater responsibilities earlier in their careers and taking on more important roles in the mission of the USAF. Vehicle maintainers are responsible for ensuring their assigned piece of equipment is operating flawlessly at all times. The Global Deicer is no exception; operators extended 50 feet in the air to de-ice an airplane expect minimal complications with their machinery. It is thus extremely important to make certain Global Deicer maintenance troops are instructed in the finest environment with the most advanced methods available. To understand the best manner in which to teach the troops, the instructors must first understand their troops' differences in learning preferences and demographic compositions. Certain types of students will flourish in different environments. The best way to understand these students is through honest communication in a non-hostile environment such as a non-intrusive survey. The troops in this study have recently finished basic training and are very conscious of the power of leadership when they arrive at technical school. An ineffective method of extracting information from them may be through instructor-student interaction. More than likely, students will feel intimidated in an environment such as this and will not honestly convey their thoughts and feelings. For that reason, an outside researcher engaged the students with a written survey to capture characteristic and preferential data. The survey was administered to 95 (90 males, 5 females) military students stationed at the Naval Surface Warfare Center, Port Hueneme Division in Port Hueneme, CA. The students were attending courses at the Air Force Maintenance Training Facility, Detachment 1, 345th Training Squadron on base. Several short courses make up the training environment; this study is concerned with a detailed maintenance techniques course on the Global Deicer.

The study is broken into three elements examining various aspects of the students at the Air Force Maintenance Training Facility. The first section looks at the learning preferences of the students. There exists a widely accredited idea that a students performance is related to the preference in which they approach a learning situation and the manner in which that learning situation is presented. Four distinct learning preferences seem to emerge from studies of individuals. From these, a teacher can tailor teaching styles to accommodate student learning preferences. The idea of differing learning preferences among individuals is pervasive in the educational literature (Fleming, 1995; Felder & Spurlin, 2005; Felder, 1988), yet there are still skeptics (Kratzig & Arbuthnott, 2006). A menagerie of research has been devoted to revealing an adequate measure of learning preferences and numerous scales exist. A popular construct and questionnaire is the Visual, Auditory, Read/Write, and Kinesthetic (VARK) developed by Neil Fleming (Fleming, 2006). This survey is used to determine how students prefer to take in and give out information, and thus can be used to enhance learning. It's been used on numerous occasions in the literature (Baykan & Nacar, 2007; Slater et al., 2007; Lujan & DiCarlo, 2006; Wehrwein et al., 2007). Students learn in different ways, and there is value in understanding the students being taught.

The second section is an exploration of the relation of various factors and their effects on student performance at the school. Several factors are explored including ASVAB scores, intellect, need for cognition, extraversion, and age. The ASVAB is a test administered to military recruits to determine proper placement in the field (ASVAB, 2009). Scores are analyzed and used to place military troops in specific jobs based on their performance in nine major areas:

- General Science
- Arithmetic Reasoning
- Word Knowledge
- Paragraph Comprehension
- Mathematics Knowledge
- Electronics Information
- Auto and Shop Information
- Mechanical Comprehension
- Assembling Objects

The study examined five composite category scores from the ASVAB; Administrative, Mechanical, General, Electrical, and the Armed Forces Qualification Test (AFQT). The Administrative score is computed from Word Knowledge and Paragraph Comprehension portions of the ASVAB. The Mechanical score is computed from the Mechanical Comprehension, General Science, and Auto and Shop Information areas. The General score is derived from the Word Knowledge, Paragraph Comprehension, and Arithmetic Reasoning areas. The Electrical score is computed from the Arithmetic Reasoning, Mathematics Knowledge, Electronics Information, and General Science sub-tests of the ASVAB. The AFQT is a percentile score between 1 and 99, indicating the percentage of testers that scored at or below the score obtained. The score is comprised of the Arithmetic Reasoning, Mathematics Knowledge, Paragraph Comprehension, and Word Knowledge areas of performance.

Intellect and extraversion are two of the Big-Five factors discovered by Lewis Goldberg (Goldberg, 1992). High extraversion includes students who are talkative, assertive, verbal, energetic, active and daring. Conversely, a low extraversion score indicates individual descriptions such as shy, quiet, reserved, inhibited, withdrawn and timid. High intellect scores explain a student who is creative, complex, imaginative, bright, philosophical, innovative and introspective. Need for cognition is the tendency for an individual to engage in and enjoy thinking and has been developed and validated in the literature (Cacioppo & Petty, 1982). Understanding the students at this level may give the instructors additional firepower to be one-step ahead in their training techniques.

Finally, an evaluation of the performance of the Wiring, Signal Tracing, and 3D Interactive Training Tool developed by Tools for Decision (TFD) Group is performed. Student performance data were collected to assist in analyzing the effectiveness of the wire tracing tool. The study hypothesized this training tool would reduce the time needed to teach complex systems, improve student understanding of complex electrical, hydraulic and pneumatic schematics and circuitry, and result in an overall increase in

student performance. The 3D interactive computerized training aid is used to teach future mechanics how to maintain/troubleshoot the Global Aircraft Deicing Vehicle. The training tool is computer based and provides detailed displays of electrical, hydraulic, and pneumatic circuits. Complex schematics are simplified by displaying one function per screen, and providing hyperlinks to other screens showing related tasks. Additionally, color-coded animations are used to trace electric, hydraulic, and air flow through various circuits. The implementing organization expects to lessen the time needed to teach complex systems while improving the overall quality of instruction. They also anticipate a cost reduction by reducing the number of operational assets committed for use as training aids. Other projected benefits include increased student comprehension/retention and faster trouble shooting during performance exercises. The school house also hopes to reduce student wash-back and attrition rates attributed to vehicle complexity. The results of this final section will allow Air Force (AF) organizations to make informed decisions regarding future course automations.

3.0 VARK ANALYSIS

It is important that an instructor understand the learning preferences of their vehicle maintenance troops. By understanding their learning preference tendencies, instructors can further tailor their teaching programs to benefit the students learning. The VARK survey was given to the students as part of the survey mentioned above and is referenced in (Fleming, 2006).

The four categories of learning are defined as visual(V), auditory(A), read/write(R), and kinesthetic(K). A student may have one preferred preference or multiple preferred preferences at varying strengths. When multiple learning preferences are present, a student is considered multi-modal. There are positives to each style, multi-modals can learn in many different settings however normally need to exercise all of these preferences to truly understand something. A student with a single preference is limited in the environments where he learns well, however once his preferred mode of learning is achieved he will understand whatever is being presented completely.

Evidence suggests that males tend towards kinesthetic learning while females prefer a read/write style of learning, our research affirms this (see Figures 1 and 2) as the majority (95 percent) of the sample was male. Figure 1 shows that the majority of maintenance students are multi-modal. Figure 2 shows the breakdown of the 78 percent of multi-modal learners in Figure 1. Figure 3 shows the overall first preferences (a combination of Figures 1 and 2) of the troops, kinesthetic is the preferred method while read/write ties with auditory for second place.

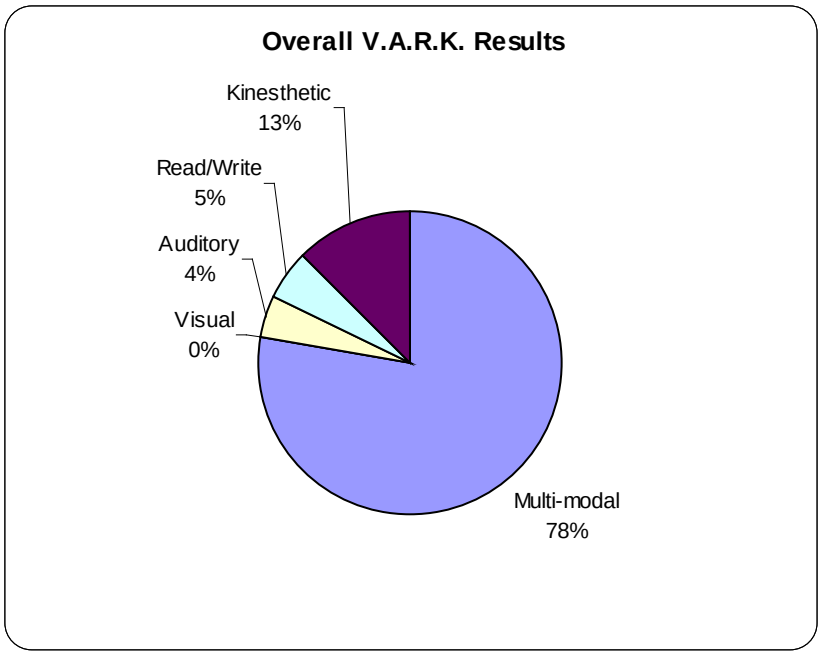

Figure 1: Overall VARK Results

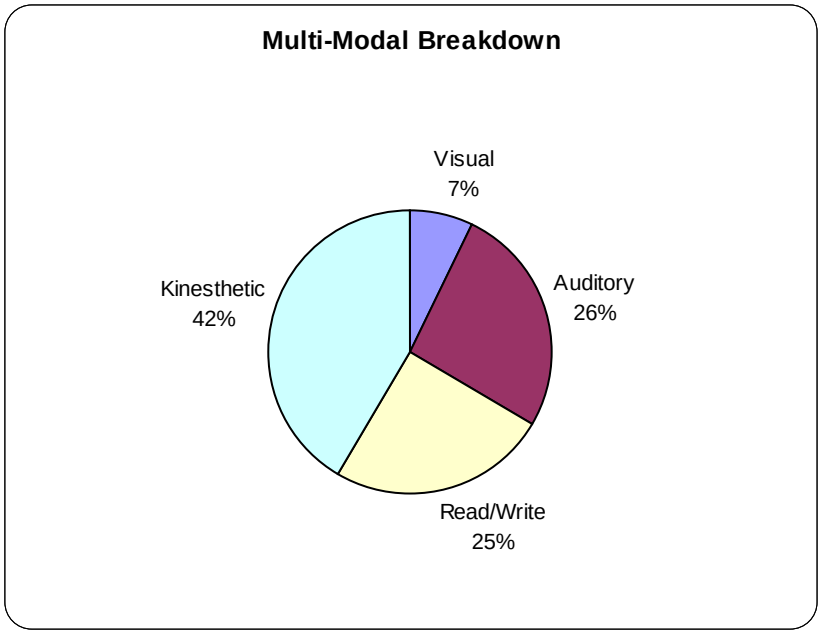

Figure 2: Multi-Modal Breakdown

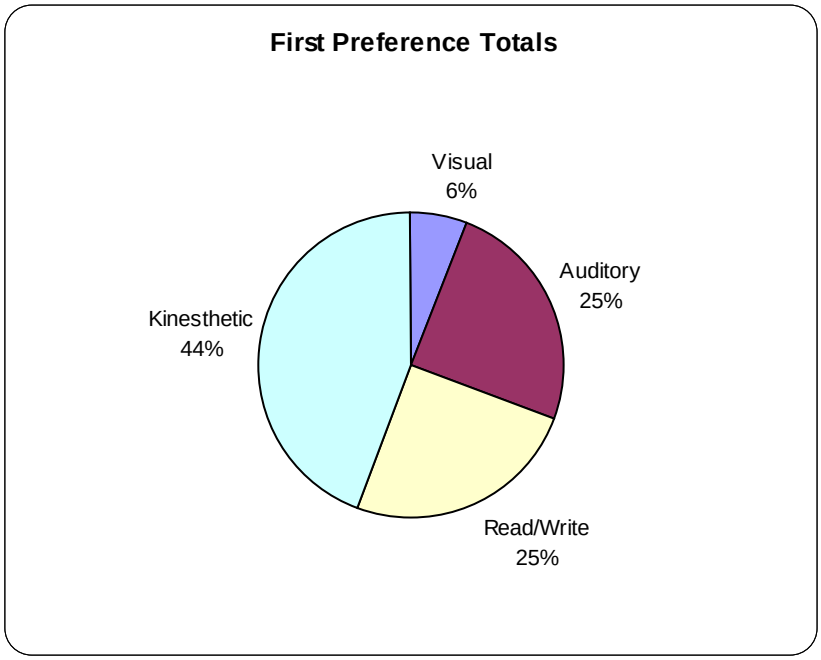

Figure 3: Overall First Preference Totals

Different vocations tend to have different learning styles as well, and kinesthetic learners will most likely gravitate towards occupations where hand-use is prevalent such as mechanics. Being aware of the majority of students learning preferences in one's domain helps teachers and leaders develop more efficient training techniques. Knowing the majority of the maintenance troops prefer one type of learning over another should lead the squadron's management to put additional resources towards this type of learning. Since the majority of the students are kinesthetic, the leaders should spend more time outside working with the vehicle. Students would benefit from spending more time exploring the actual Global Deicer vehicle and being allowed to practice on the wiring itself. Another idea to account for auditory and read/write learners may be to hand out reading material regarding the wiring schematics in addition to lectures and then pushing the students to write their own descriptions of the material they are learning.

Additional recommendations and further guidance can be obtained at <http://www.vark-learn.com>.

4.0 ANALYSIS

In addition to learning preferences, the survey administered also collected student ratings for intellect, extraversion, and need for cognition. ASVAB scores, performance check test scores, final test scores, and an instructor rating were also gathered as dependent variables. This section answers several questions and explores some of the relationships between variables.

The performance check is given after 3 days of classroom exposure to the written material; the students haven't physically worked on the vehicle at the time the test is given. The students are allowed to repair the actual vehicles with their hands the following week before the final test is given. Interestingly, the kinesthetic learners are the lowest performers on the initial performance check and the highest performers on the final test. They start performing well after they have spent hands-on time with the vehicle. The kinesthetic learners are the only group who showed any significant variation between the performance check and the final test; see Table 1. In fact, the final test scores of the three other types of learners were lower than their initial performance checks. This shows the necessity of allowing the students to spend a lot of time working on the actual vehicle. Finding other ways to reach the students with other learning preferences could also boost final test scores.

Table 1: Results (Performance Check/Final Test)

	Written PC Average	Final Test Average	Statistically Different?
Aural	87.86	86.43	No
Kinesthetic	81.14	90.86	Yes
Read/Write	88.57	86.43	No
Visual	86.00	83.00	No

Does a student's age affect their performance? It may be possible to better organize learning groups based on the students' ages. Rather than putting all the young students in one group and the older students in another group, the instructors could put one of each age group into a learning group together to increase diversity. An analysis of variance (ANOVA) test was performed on three age groups as shown in Tables 2 and 3.

Table 2: ANOVA Results by Age Group

Age	Final Test Average	Standard Dev
18-22	85.93	9.2
23-39	94.44	5.1
40+	87.14	12.2

Table 3: ANOVA Results Between/Within Age Groups

	SS	MS	P-value
Between Age Groups	1040.160819	520.0804	0.002018
Within Age Groups	7201.944444	78.282	

There is sufficient evidence to reject the claim that the three age groups come from populations with the same mean. There exists a significant difference between the three age groups, with the students aged 23-39 being the top performers on the written tests. The young students performed considerably less than the middle age group. The reasons for this could include the fact that young newly enlisted troops have historically been known to prioritize social interaction during the first years of service as opposed to intense focus on mission. Reasons for lower scores from the oldest group may be the struggle to regain good study habits and loss of knowledge from high school shop courses. If study groups or learning teams are used during the course, it may be beneficial to better disperse the different age groups rather than allow a group of solely 40+ or 18-22 year-olds.

Learning preferences don't appear to have a direct influence on test scores as shown in Tables 4 and 5. Although it appears the kinesthetic learners scored much higher than the visual learners, the number of data points led to an insignificant statistical conclusion. It is noted however that the visual learners were the lowest performers on the tests. This should lead the instructors to seek out additional visual learning aids in order to reach the visual learners more effectively.

Table 4: Learning Preferences Results by Test Scores

Learning Preference	Final Test Average	Standard Dev
Aural	86	11.0
Kinesthetic	91	8.7
Read/Write	86	9.0
Visual	83	10.4

Table 5: Learning Preferences Between/Within Preferences

	SS	MS	P-value
Between Learning Preferences	491.8095238	163.9365079	0.14032
Within Learning Preferences	6182.857143	87.08249497	

Learning preference correlations are shown in following chart.

Correlations

		AGE	ADMIN	MECH	GEN	ELECT	AFQT	Needforcognition	Extraversion	Intellect	Learning Preference	Block2test	Written PCScore	Instructor Rating
AGE	Pearson Correlation	1	-.361**	.145	-.074	-.158	-.210*	.017	-.264**	-.140	.040	.156	.069	.159
	Sig. (2-tailed)		.000	.162	.475	.126	.048	.869	.010	.175	.731	.130	.505	.126
	N	95	95	95	95	95	89	95	95	95	75	95	95	94
ADMIN	Pearson Correlation	-.361**	1	.397**	.663**	.749**	.923**	.138	.063	.378**	-.067	.051	-.014	.125
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.182	.544	.000	.568	.625	.894	.230
	N	95	95	95	95	95	89	95	95	95	75	95	95	94
MECH	Pearson Correlation	.145	.397**	1	.756**	.651**	.590**	.021	-.123	.201	-.159	.225*	.022	.133
	Sig. (2-tailed)	.162	.000		.000	.000	.000	.840	.236	.051	.172	.028	.836	.202
	N	95	95	95	95	95	89	95	95	95	75	95	95	94
GEN	Pearson Correlation	-.074	.663**	.756**	1	.678**	.882**	.115	.049	.402**	-.062	.157	-.039	.134
	Sig. (2-tailed)	.475	.000	.000		.000	.000	.267	.635	.000	.599	.129	.710	.197
	N	95	95	95	95	95	89	95	95	95	75	95	95	94
ELECT	Pearson Correlation	-.158	.749**	.651**	.678**	1	.784**	.120	.002	.327**	-.131	.080	-.064	.122
	Sig. (2-tailed)	.126	.000	.000	.000		.000	.247	.984	.001	.262	.443	.536	.242
	N	95	95	95	95	95	89	95	95	95	75	95	95	94
AFQT	Pearson Correlation	-.210*	.923**	.590**	.882**	.784**	1	.141	.080	.393**	-.054	.162	-.117	.147
	Sig. (2-tailed)	.048	.000	.000	.000	.000		.187	.457	.000	.660	.129	.275	.171
	N	89	89	89	89	89	89	89	89	89	69	89	89	88
Needforcognition	Pearson Correlation	.017	.138	.021	.115	.120	.141	1	.142	.420**	-.115	.084	-.053	.095
	Sig. (2-tailed)	.869	.182	.840	.267	.247	.187		.169	.000	.324	.419	.608	.361
	N	95	95	95	95	95	89	95	95	95	75	95	95	94
Extraversion	Pearson Correlation	-.264**	.063	-.123	.049	.002	.080	.142	1	.522**	.033	.058	-.251*	-.158
	Sig. (2-tailed)	.010	.544	.236	.635	.984	.457	.169		.000	.778	.578	.014	.129
	N	95	95	95	95	95	89	95	95	95	75	95	95	94
Intellect	Pearson Correlation	-.140	.378**	.201	.402**	.327**	.393**	.420**	.522**	1	.005	.101	-.047	.131
	Sig. (2-tailed)	.175	.000	.051	.000	.001	.000	.000	.000		.967	.328	.649	.208
	N	95	95	95	95	95	89	95	95	95	75	95	95	94
LearningPreference	Pearson Correlation	.040	-.067	-.159	-.062	-.131	-.054	-.115	.033	.005	1	-.112	.062	.050
	Sig. (2-tailed)	.731	.568	.172	.599	.262	.660	.324	.778	.967		.338	.600	.670
	N	75	75	75	75	75	69	75	75	75	75	75	75	74
Block2test	Pearson Correlation	.156	.051	.225*	.157	.080	.162	.084	.058	.101	-.112	1	-.051	.384**
	Sig. (2-tailed)	.130	.625	.028	.129	.443	.129	.419	.578	.328	.338		.623	.000
	N	95	95	95	95	95	89	95	95	95	75	95	95	94
WrittenPCScore	Pearson Correlation	.069	-.014	.022	-.039	-.064	-.117	-.053	-.251*	-.047	.062	-.051	1	.289**
	Sig. (2-tailed)	.505	.894	.836	.710	.536	.275	.608	.014	.649	.600	.623		.005
	N	95	95	95	95	95	89	95	95	95	75	95	95	94
InstructorRating	Pearson Correlation	.159	.125	.133	.134	.122	.147	.095	-.158	.131	.050	.384**	.289**	1
	Sig. (2-tailed)	.126	.230	.202	.197	.242	.171	.361	.129	.208	.670	.000	.005	
	N	94	94	94	94	94	88	94	94	94	74	94	94	94

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

It appears from the correlations table above that as age increases, AFQT and ADMIN scores decrease-the younger troops score higher. Younger students have a recently completed high school and are likely still relatively sharp in a learning sense.

Age is also negatively correlated to extraversion. That is, younger students appear to be more extroverted.

It is no surprise that those students with higher mechanical scores on the ASVAB scored higher on the final exam; this is further validation of the ASVAB.

Each of the correlations between the different parts of the ASVAB appears to be showing strong correlation. This would be expected as the ASVAB categories are composite scores from different combinations of the nine major areas given in Section 1. However, this also indicates a general intelligence that seems to prevail over the entire test. If each score is correlated, the tester who does well on one part of the test will most likely achieve high scores on all parts of the test. The ASVAB scores are also strongly correlated to the Intellect variable further indicating a relationship between higher intelligence and higher ASVAB scores.
Intellect was found to be strongly correlated to Need for Cognition and Extraversion.

Finally, the Instructor Rating for each of the students was strongly correlated to the performance check and final test scores indicating that the instructors are cognizant of which students appear to be learning the course material.

5.0 BENEFITS ANALYSIS

The fabricators of the enhanced software program claim benefits such as increased learning and heightened knowledge of the maintenance required on the vehicle. Interestingly, test scores and independent performance evaluations paint a different picture. Table 6 shows justification that the scores using the new instruction program are in fact statistically identical to the scores using previous methods of instruction. For simplicity, prior method of instruction using the paper schematic is referred to as method I while the new computer instruction method is method II. The point estimate used from the independent samples is the sample mean, $\bar{x}$, an estimate of the true mean $\mu_{\bar{x}}$.

Table 6: Score Justification

	$\overline{X}$	$\overline{S}$	n	z	Result
β_1	85.70	13.73	121	-.03	Fail to reject $H_0 : \beta_1 = \beta_2$
β_2	85.76	9.69	33		
τ_1	87.24	9.61	76	.54	Fail to reject $I_0 : \tau_1 = \tau_2$
τ_2	85.82	8.38	79		
δ_1	6.81	1.68	86	-1.02	Fail to reject $J_0 : \delta_1 = \delta_2$
δ_2	7.07	1.15	44		

The measures of performance used to compare instruction method's I and II include a written performance check score, the final test score, and an instructor rating of the overall competency of the student. The written performance check is given midway through the two week course giving the instructors an idea of student comprehension of the material. The final test score is given at the end of the course and is comprehensive in nature. Following the course, the instructor evaluates each student based on observations during the course and assigns a comprehension rating between 1 and 10, 1 being poor and 10 being excellent.

The original claim states this improved training technique will increase student performance and understanding. Since the null hypothesis must contain equality, $H_0 : \mu_1 = \mu_2$, and the original claim is $H_1 : \mu_1 \neq \mu_2$. The probability of making the mistake of rejecting the null hypothesis when it is true is set at $\alpha = .01$, this is the significance level. Thus the z statistic in Table 6 must be less than -2.575 if an increase in knowledge exists and above 2.575 a decrease in knowledge can be declared due to the enhanced training aid.

β – Performance Check Score
τ – Final Test Scores
δ – Instructor Rating

The point estimates of the performance scores, test scores, and instructor ratings are similar, thus resulting in a z statistic that fails to fall in the critical region. A slight decrease in final test scores was observed, however not enough to declare statistical significance. Conversely, a slight increase in instructor rating occurred under the new method, yet not enough to be establish statistical significance. With mathematical surety, we claim the enhanced training technique fails to increase mechanical knowledge on the Global Deicer as measured by test scores and instructor ratings. Interestingly enough, prior to implementation of the new tool, students were polled to determine whether they felt a tool of this type would allow them to learn the schematics better. 60 percent of the students felt a tool would increase their ability to learn the schematic, 21 percent thought a computerized tool would not help, and 19 percent were unsure. Additionally, 55 percent of the students felt this type of tool would increase their performance during parts of the course, 18 percent felt it would not increase performance, and 27 percent were unsure. There seems to be a common belief among young students that computerized teaching methods are better than traditional methods. This may be more of a 21st century preference than anything else. As demonstrated in the above analysis, a computerized tool did not change performance metrics. The students polled after implementation of the new tool slightly agreed (4.8 average on a 7 point scale) that the tool did make it easier for them to learn the schematic.

6.0 ADDITIONAL SURVEY INFORMATION

Almost half the students, 47 percent, felt they would have learned better had the teachers made the class more interactive by engaging the students more often. The students were also asked whether they felt the class was going too fast. On a scale of 1 to 7, with 1 being a strongly disagree and 7 being a strongly agree, the student average was 2.3. The students generally disagreed with this statement and felt the class is moved at an adequate speed.

The students provided valuable feedback in their answers to the questions administered. The rest of this section looks at the responses to a few of the questions asked on the survey to give the course directors better insight into the students.

The following comments from the students are in response the things the instructor did that were helpful in learning the material. The questions are taken from Appendix A and B, questions 50 and 51 respectively.

Made information understandable, easy to understand. Information was passed at a good pace.
Hands on training.
Walked through with us exactly what we needed to learn.
He worked only as fast as the group could understand which was helpful.
Hands on demonstration and practice.
Use a powerpoint style of teaching and provide a student handout for us to read over.
Let me try it out.
Put the information out in the class room; then walked class through how the system being covered is supposed to work, answered any questions then broke into smaller groups and gives PC.
My instructor asked a lot of questions that forced interaction among the students. My instructor performed exceptional demonstrations of what he was teaching.
Give me and these others time to review, plus stress on the material we were working on in class and lab.
Read through the material and talked about it in further depth by using real world scenarios and personal past experience and answered any and all questions that we had.
The instructor helped by answering all my questions in a way it was easy to understand. He would also ask some questions over and over again to let us know it was important for us to remember.
The instructor used visual aids and demonstrated on the actual equipment. This was extremely helpful since I am a hands-on type of learner.
Took us down to the deicer and showed us the parts and explained how they worked and what other components they effected.
If he did not know the information he would find an answer.
Relate parts of the schematic to, computers and other everyday products.
Demonstrations on the vehicle.
Showed me what I needed to know.
He was energetic and seemed to want to be here to help us, he did his best to make sure we were understanding and was always open to questions
Quiz about the material and gave the class enough time to complete labs.
Walked the class through what we were going to do first and explained everything we were going to be doing for that day.

He explained schematics over and over so we could understand.
Let me learn at my own pace.
He let us ask questions and answered them to the best he could.
He used a lot of training aids. The simplified schematic was also helpful.
Had us work on the vehicle a lot.
Explained everything then showed us on the truck itself.
Explain functions by tracing the visual.
He talked about the subject, then goes and previews it on the truck itself.
Took us out to the deicer and showed us everything. Then showed us in advance what was going to be in the lab and let us practice.
Repeat himself as many times we need it to hear the explanation plus his knowledge on the deicer helped us understanding better, and the hands on job was great helping us to understand better each one of the components.
Color coded and went over it in class.
Answer all of my questions to the best of his ability.
Explained things and answered any questions that we had.
No comment.
He took his time.
He pointed out key points of the schematic like when certain things got power and why.
Took us out to the vehicle and showed us the components.
The instructor would go through and explain where on the deicer a certain part was how it related to the material
When in the lab he pointed at components that were in the packet that didn't have pics of them.
The labs helped out a lot demonstrating then practicing.
Using visual aids and explaining everything in great detail helped throughout the course.
They went over the material. Made sure that we all knew what exactly he was talking about.
He took the class out to the vehicle and showed us where the parts were located and explained how they worked.
Our instructor gave us the powerpoint presentation to study with as well as the study guide. Also, he demonstrated the lab portion of the block well, and showed good confidence in what he was doing.
He made jokes and talked in an excited voice which kept me interested.
The instructor took us out to the vehicle and showed us physically how everything worked.
Give examples.
He was active with the class and made sure he went over things more than once until we learned it.
Took the group out on label.
The instructor really cared about us grasping the concept....if something was unclear he would clarify it and make sure it stayed that way by taking the time to do so....during lab he was forgiving unless students or equipment were put in danger....
He went over the material until we all thought we understood it.
Related the material to things we already knew. Also repetition is key with instilling the information upon us. Interaction personally helps me to learn the material better than just the instructor lecturing the entire session.
Labs helped a lot.
Our instructor described everything that we needed to know in detail. He also gave anyone who needed one-on-one time an opportunity.
The instructor TSSG Baltes was a great instructor. He made sure that we understood the material before we move on to the next chapter.
By explaining each fundamental of the vehicle then showing us what they are talking about. Also explaining things we don't understand better.

He was descriptive and helped the individuals that needed extra assistance.
The instructor tried not to make the material so dry and boring which helped a lot in learning and paying attention to the lesson. Showing us what we are going to need to do in the field before we began a lab really helped a lot.
What helped me was when the instructor said we had to go around the room giving one fact about the global deicer.
Always asked if we got questions and went over the material over and over again.
The instructor explained systems in detail and used training aids to help the class understand. The instructor was open to questions throughout the class about the material.
Covering the material in more than one manner. By using handouts, lecture and hands on training all learning methods i.e., auditory, visual etc., enable students to grasp the information in more than one way.
Showed us pictures, and models of the parts discussed. We also did a mini review after every 3-4 slides.
Used visuals and labs.
Answer questions and show us examples of parts and how they work.
Showed the different parts and how they worked. Cut-aways are a great help.
He went over everything several times and he was confident in what he knew.
He seemed knowledgeable on each topic and confident in his teachings.
Took time to explain where certain components connected and how they were actuated. Being able to visualize the actual layout of the schematic on the vehicle helps me when I get to the labs.
Took it slow and made sure that all of the students where on the same page before he pushed on to the next item or unit
Said things in a calm manner.
Labs, and answers, questions. He made it fun.
The instructor has a lot of knowledge on this particular vehicle. He used visual aids of parts and animation on the schematics.
n/a
Repeated important information and answered questions.
Explained it in labs and handouts.
Associated material to either actual part or schematic.
He was very realistic in explaining it and he took the time to help solve any misunderstandings.
Explained the topic in lab and how we could fix the problems.
Show us in the lab what we were going to learn and then teach us. It was very helpful.
Took us out to the vehicle and showed us physically what we were talking about.
Class participation.
Nothing.

I don't feel that the instructor could have made the program easier to understand I feel like the program its self is what's going to make it easier to harder to understand, there needs to be more viewability and maneuverability within the trace portion of the program or it just needs to be done away with completely.
He could have taught the material in a basic level, he was teaching use like we knew the material. Like it was college level class.
Some of the material did not need to be explained on the program, rather taught straight forward. Only to be on the program as a reference.
He could have allowed the slides to remain on the smart board, so that I knew what information was important to highlight in the student guide.
If the instructor wouldn't have gone into so much detail and just let us search over the program I think it would have been a lot faster and more time effective.
He could have taken more time teaching us how to work the computer program.
He could have gone over the slide show more detailed.

Nothing, if you teach it right I'll learn it right.
No comment.
In my experience in Block 2 SSgt Lamar did an excellent job. He knew the material and showed us how to use the material in the classroom and out in the shop.
I don't know what else he could have down more.
Nothing that I can think of.
Material was delivered in a professional manner.
For the first time using the P2Sim and P2Trace program I believe he did a great job.
He could have had the bugs fixed if it was in his power to do so.
Nothing really. I would have liked more questions on the schematics because it helps me learn.

The following comments from the students give suggestions to the instructors on things the students thought the instructors could have done to teach the material more effectively. The questions are taken from Appendix A and B, questions 51 and 52, respectively.

Nothing. Instructor did an outstanding job.
Not so in depth during powerpoints.
He periodically jumped around. Staying focused on one system probably would have been more effective.
I felt that he did a fine job of teaching.
Speed up the course.
Slowed down when covering schematics and make sure that the information being presented is correct and does not have any mistakes. The instructor could have given a review over the schematics to make sure everything was clear on how to read them.
More hands on time.
Better organized material to work with.
Considering I got a 100 percent on the deicer block test, not much. I feel computer based schematics would be a good addition though.
A little more visual aids and more time in the lab.
Nothing.
I don't believe there is anything more that the instructor could have done to teach the material better. I believe the instructor did a good job at helping me learn the material.
There is nothing that I can think of. He was very knowledgeable about the Global Deicer.
Nothing.
Review each subject to refresh my memory.
Being 100% sure on some material.
More time for subject material and hands on.
More time.
Possibly just a little bit more time to go over the details. Only one day more in the class would help a lot I believe.
Spend a little more time on preparing the material that is taught to the class.
No comment.
No comment.
Not sure, the material was presented very well.
I think more lab time would be helpful.
He did a pretty good job.
Nothing.
Nothing really he did a good job.
Gotten deeper into some concepts.

Not much really he did a pretty good job.
Nothing really I pretty much liked how it was taught.
I think maybe a little more of space to work in the schematics.
Went slower.
More review before the test would have been extremely helpful.
Instructors did a good job.
No comment.
I'm not sure at the moment.
No comment.
More time on the functions of the deicer and what they are all used for.
Nothing really he was really informed and was able to answer all and any questions asked during class.
No comment.
Slow down and go over key points.
Overall the instructor's abilities in the course were helpful in the aid of learning.
Nothing. I learned the information very well.
I thought he done all that he could to help the class learn the material.
Nothing. There is no way to make the material we're learning fun except more lab style PC's.
I think he was great and the only thing I had trouble with was reading the electrical schematics but then again it might be my lack of interest in them.
Nothing.
More training aids.
Nothing at all, I feel the instructor was a great instructor and he helped me learn the material very well.
More pc on different parts.
All the instructors thus far have been excellent.
I believe that he taught it very well.
More interaction.
He did real well.
Everything was great.
He did a great job.
None.
Been a little more energetic to keep the class awake.
I honestly don't think the instructor could have done anything more, maybe extending the course would help some of the students out.
I feel like the instructor did a good job at teaching the material.
Nothing really.
The instructor was great, yet I feel for maybe some classmates the pace in some portions may have been a little fast.
Not much.
Showed more visual aids.
Had more labs.
n/a
The instructor did a really great job, went a steady pace all the way and got through the lessons.
Nothing.
Nothing I can think of.
Nothing. We can only learn so much by listening to an instructor. We have to go the rest of the way to learn it ourselves.
More hands on instructions.

A little more room at the desks.
I think we need more pc type tests periodically, but more often than we do now.
There is nothing wrong with the teaching. It will be great to make the block longer.
n/a
Related functions to other similar type functions.
n/a
No comment.
Maybe review.
Give us more time and review.
Nothing, it was pretty dry material but it was taught in an interesting way that was able to keep my attention for the most part.
n/a
No comment.
Taken it a little slower.
No comment.
I don't feel that the instructor could have made the program easier to understand I feel like the program its self is what's going to make it easier to harder to understand, there needs to be more viewability and maneuverability within the trace portion of the program or it just needs to be done away with completely.
He could have taught the material in a basic level, he was teaching use like we knew the material. Like it was college level class.
Some of the material did not need to be explained on the program, rather taught straight forward. Only to be on the program as a reference.
He could have allowed the slides to remain on the smart board, so that I knew what information was important to highlight in the student guide.
If the instructor wouldn't have gone into so much detail and just let us search over the program I think it would have been a lot faster and more time effective.
He could have taken more time teaching us how to work the computer program.
He could have gone over the slide show more detailed.
Nothing, if you teach it right I'll learn it right.
No comment.
In my experience in Block 2 SSgt Lamar did an excellent job. He knew the material and showed us how to use the material in the classroom and out in the shop.
I don't know what else he could have down more.
Nothing that I can think of.
Material was delivered in a professional manner.
For the first time using the P2Sim and P2Trace program I believe he did a great job.
He could have had the bugs fixed if it was in his power to do so.
Nothing really. I would have liked more questions on the schematics because it helps me learn.

7.0 CONCLUSIONS

The importance of properly training our soldiers cannot be ignored if we are to continue as the world's most respected military. Understanding the vehicle maintenance troops learning preferences allows the instructors to better equip their students with the material they need to perform at the highest possible levels. The relationships between the variables collected and course performance allow the instructors to preemptively spot students who maybe potential poor performers. Younger or older students with low mechanical ASVAB scores and a visual learning preference may be at a disadvantage when entering the course. Middle age students with high mechanical ASVAB scores and a kinesthetic learning preference could be matched up with these students as learning buddies. This could possibly help the wash-back rate.

Given the statistically significant improvement of kinesthetic learners after working on the actual vehicle, the goal of reducing the number of operational assets committed for use as training aids by implementing the Wiring, Signal Tracing, and 3D Interactive Training Tool may not be realized. The new training tool did not appear to have any effect on student comprehension as evident from test scores and instructor ratings. Effects on knowledge retention were not measured. There may be other benefits not examined in this paper that warrant the implementation of the tool. The tool was designed to aid a maintainer in tracing complex schematics and wiring diagrams. Therefore, this tracing tool may potentially reduce actual maintenance time on the vehicle versus using paper schematics. However, this would need to be examined in a future study.

REFERENCES

ASVAB. Armed Services Vocational Aptitude Battery. [Online: http://www.official-asvab.com/index]. Accessed 23 July 2009.

Baykan, Z., & Nacar, M. (2007). Learning styles of first-year medical students attending Erciyes University in Kayseri, Turkey. *Advances in Physiology Education*, 31:158-160.

Cacioppo, J.T., & Petty, R.E. (1982). The need for cognition. *Journal of Personality and Social Psychology.* 42(1): 116-131.

Felder, R.M., & Silverman, L.K. (1988). Learning and teaching styles in engineering education. *Engineering Education,* 78(7): 674-681.

Felder, R.M., & Spurlin, J.E. (2005). Applications, reliability, and validity of the index of learning styles. *Intl. Journal of Engineering Education,* 21(1): 103-112.

Fleming, N.D. (1995). I'm different, not dumb: Modes of presentation (V.A.R.K) in the tertiary classroom. In A. Zelmer (Ed.), *Research and Development in Higher Education, Proceedings of the 1995 Annual Conference of the Higher Education and Research Development Society of Australasia* (HERDSA), 18:308-313.

Fleming, N.D. (2006). VARK: A guide to learning styles. [Online: http://www.vark-learn.com/english/page.asp?p=questionnaire]. Copyright Version 7.0 (2006) held by Neil D. Fleming, Christchurch, New Zealand and Charles C. Bonwell, Green Mountain Falls, CO.

Goldberg, L.R. (1992). The development of markers for the Big-Five Factor structure. *Psychological Assessment.* 4(1):26-42.

Kratzig, G.P., & Arbuthnott, K.D. (2006). Perceptual learning style and learning proficiency: A test of the hypothesis. *Journal of Education Psychology*, 98(1): 238-246.

Lujan, H.L., & DiCarlo, S.E. (2006). First-year medical students prefer multiple learning styles. *Advances in Physiology Education*, 30:13-16.

Slater, J.A., Lujan, H.L., & DiCarlo, S.E. (2007). Does gender influence learning style preferences of first-year medical students. *Advances in Physiology Education*, 31:336-342.

Wehrwein, E.A., Lujan, H.L., & DiCarlo, S.E. (2007). Gender differences in learning style preferences among undergraduate physiology students. *Advances in Physiology Education*, 31:153-157.

APPENDIX A: Student Survey (Current Method of Instruction)

For questions 1 through 30 please circle the number that best describes you.

Strongly Disagree						Strongly Agree
1	2	3	4	5	6	7

1. I like to solve complex problems.

   1 2 3 4 5 6 7

2. I need things explained only once.

   1 2 3 4 5 6 7

3. I can handle a lot of information.

   1 2 3 4 5 6 7

4. I love to think up new ways of doing things.

   1 2 3 4 5 6 7

5. I am quick to understand things.

   1 2 3 4 5 6 7

6. I love to read challenging material.

   1 2 3 4 5 6 7

7. I have difficulty understanding abstract ideas.

   1 2 3 4 5 6 7

8. I try to avoid complex people.

   1 2 3 4 5 6 7

9. I avoid difficult reading material.

   1 2 3 4 5 6 7

10. I avoid philosophical discussions.

1 2 3 4 5 6 7

11. I am the life of the party.

1 2 3 4 5 6 7

12. I feel comfortable around people.

1 2 3 4 5 6 7

13. I don't talk a lot.

1 2 3 4 5 6 7

14. I start conversations.

1 2 3 4 5 6 7

15. I keep in the background.

1 2 3 4 5 6 7

16. I have little to say.

1 2 3 4 5 6 7

17. I don't like to draw attention to myself.

1 2 3 4 5 6 7

18. I talk to a lot of different people at parties.

1 2 3 4 5 6 7

19. I don't mind being the center of attention.

1 2 3 4 5 6 7

20. I am quiet around strangers.

1 2 3 4 5 6 7

21. I have a rich vocabulary.

1 2 3 4 5 6 7

22. I have a vivid imagination.

1 2 3 4 5 6 7

23. I have difficulty understanding abstract ideas.

1 2 3 4 5 6 7

24. I have excellent ideas.

1 2 3 4 5 6 7

25. I am quick to understand things.

1 2 3 4 5 6 7

26. I am not interested in abstract ideas.

1 2 3 4 5 6 7

27. I do not have a good imagination.

1 2 3 4 5 6 7

28. I use difficult words.

1 2 3 4 5 6 7

29. I spend time reflecting on things.

1 2 3 4 5 6 7

30. I am full of ideas.

1 2 3 4 5 6 7

For questions 31 through 46 please circle the letter or letters that best describe you.

31. You are helping someone who wants to go to your airport, town centre or railway station. You would:

a. Go with her.
b. Tell her the directions.
c. Write down the directions (without a map).
d. Draw, or give her a map.

32. You are not sure whether a word should be spelled `dependent' or `dependant'. You would:

a. See the words in your mind and choose by the way they look.
b. Think about how each word sounds and choose one.
c. Find it in a dictionary.
d. Write both words on paper and choose one.

33. You are planning a holiday for a group. You want some feedback from them about the plan. You would:

a. Describe some of the highlights.
b. Use a map or website to show them the places.
c. Give them a copy of the printed itinerary.
d. Phone, text or email them.

34. You are going to cook something as a special treat for your family. You would:

a. Cook something you know without the need for instructions.
b. Ask friends for suggestions.
c. Look through the cookbook for ideas from the pictures.
d. Use a cookbook where you know there is a good recipe.

35. A group of tourists want to learn about the parks or wildlife reserves in your area. You would:

a. Talk about, or arrange a talk for them about parks or wildlife reserves.
b. Show them internet pictures, photographs or picture books.
c. Take them to a park or wildlife reserve and walk with them.
d. Give them a book or pamphlets about the parks or wildlife reserves.

36. You are about to purchase a digital camera or mobile phone. Other than price, what would most influence your decision?

a. Trying or testing it.
b. Reading the details about its features.
c. It is a modern design and looks good.
d. The salesperson telling me about its features.

37. Remember a time when you learned how to do something new. Try to avoid choosing a physical skill, e.g., riding a bike. You learned best by:

a. Watching a demonstration.
b. Listening to somebody explaining it and asking questions.
c. Diagrams and charts - visual clues.
d. Written instructions – e.g., a manual or textbook.

38. You have a problem with your knee. You would prefer that the doctor:

a. Gave you a web address or something to read about it.
b. Used a plastic model of a knee to show what was wrong.
c. Described what was wrong.
d. Showed you a diagram of what was wrong.

39. You want to learn a new program, skill or game on a computer. You would:

a. Read the written instructions that came with the program.
b. Talk with people who know about the program.
c. Use the controls or keyboard.
d. Follow the diagrams in the book that came with it.

40. I like websites that have:

a. Things I can click on, shift or try.
b. Interesting design and visual features.
c. Interesting written descriptions, lists and explanations.
d. Audio channels where I can hear music, radio programs or interviews.

41. Other than price, what would most influence your decision to buy a new non-fiction book?

a. The way it looks is appealing.
b. Quickly reading parts of it.
c. A friend talks about it and recommends it.
d. It has real-life stories, experiences and examples.

42. You are using a book, CD or website to learn how to take photos with your new digital camera. You would like to have:

a. A chance to ask questions and talk about the camera and its features.
b. Clear written instructions with lists and bullet points about what to do.
c. Diagrams showing the camera and what each part does.
d. Many examples of good and poor photos and how to improve them.

43. Do you prefer a teacher or a presenter who uses:

a. Demonstrations, models or practical sessions.
b. Question and answer, talk, group discussion, or guest speakers.
c. Handouts, books, or readings.
d. Diagrams, charts or graphs.

44. You have finished a competition or test and would like some feedback. You would like to have feedback:

a. Using examples from what you have done.
b. Using a written description of your results.
c. From somebody who talks it through with you.
d. Using graphs showing what you had achieved.

45. You are going to choose food at a restaurant or cafe. You would:

a. Choose something that you have had there before.
b. Listen to the waiter or ask friends to recommend choices.
c. Choose from the descriptions in the menu.
d. Look at what others are eating or look at pictures of each dish.

46. You have to make an important speech at a conference or special occasion. You would:

a. Make diagrams or get graphs to help explain things.
b. Write a few key words and practice saying your speech over and over.
c. Write out your speech and learn from reading it over several times.
d. Gather many examples and stories to make the talk real and practical.

For questions 47 through 54, please circle the appropriate response and/or provide comments as necessary.

47. During performance progress checks, did anything affect your ability to observe the paper schematics? (If yes, please explain)

a. Yes
b. No

Comments:

48. Generally speaking, you are:

a. A slow learner
b. A fast learner

49. Based on the following description, do you believe a computerized training aid would have allowed you to learn the schematics portion of the deicer course better than with the current method of instruction?

The training tool is laptop based and provides detailed displays of electrical, hydraulic, and pneumatic circuits. It simplifies complex schematics by displaying

one function per screen, and provides hyperlinks to other screens showing related tasks. In addition, color-coded animations are used to trace electric, hydraulic, and air flow through various circuits.

a. Yes
b. No
c. Unsure

Comments:

50. Based on the description of a computerized training aid (given in question 49), do you feel the training aid would have enhanced your performance during the performance progress check portions of the deicer course?

a. Yes
b. No
c. Unsure

Comments:

51. What did the instructor do that was helpful in your learning of the material?

52. What could the instructor have done better to teach you the material?

53. How many hours (or minutes) did you spend outside the classroom studying the Global Deicer schematic diagrams?

54. Do you think you would have learned better if the class was more interactive, that is if the teacher engaged the students more often?

a. Yes
b. No
c. Unsure

Comments:

For questions 55 through 57, circle the number that corresponds to your level of agreement or disagreement.

Strongly Disagree						Strongly Agree
1	2	3	4	5	6	7

55. I fell behind during the class because everything was going so fast.

1 2 3 4 5 6 7

56. I prefer to write things out as opposed to seeing things happen.

1 2 3 4 5 6 7

57. I learn better by touching/hands-on exercises than by watching events happen.

1 2 3 4 5 6 7

APPENDIX B: Student Survey (Wire Signal and Tracing Tool)

For questions 1 through 30 please circle the number that best describes you.

Strongly Disagree						Strongly Agree
1	2	3	4	5	6	7

1. I like to solve complex problems.

   1 2 3 4 5 6 7

2. I need things explained only once.

   1 2 3 4 5 6 7

3. I can handle a lot of information.

   1 2 3 4 5 6 7

4. I love to think up new ways of doing things.

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b. Think about how each word sounds and choose one.
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d. Write both words on paper and choose one.

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b. Use a map or website to show them the places.
c. Give them a copy of the printed itinerary.
d. Phone, text or email them.

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c. It is a modern design and looks good.
d. The salesperson telling me about its features.

37. Remember a time when you learned how to do something new. Try to avoid choosing a physical skill, e.g., riding a bike. You learned best by:

a. Watching a demonstration.
b. Listening to somebody explaining it and asking questions.
c. Diagrams and charts - visual clues.
d. Written instructions – e.g., a manual or textbook.

38. You have a problem with your knee. You would prefer that the doctor:

a. Gave you a web address or something to read about it.
b. Used a plastic model of a knee to show what was wrong.
c. Described what was wrong.
d. Showed you a diagram of what was wrong.

39. You want to learn a new program, skill or game on a computer. You would:

a. Read the written instructions that came with the program.
b. Talk with people who know about the program.
c. Use the controls or keyboard.
d. Follow the diagrams in the book that came with it.

40. I like websites that have:

a. Things I can click on, shift or try.
b. Interesting design and visual features.
c. Interesting written descriptions, lists and explanations.
d. Audio channels where I can hear music, radio programs or interviews.

41. Other than price, what would most influence your decision to buy a new non-fiction book?

a. The way it looks is appealing.
b. Quickly reading parts of it.
c. A friend talks about it and recommends it.
d. It has real-life stories, experiences and examples.

42. You are using a book, CD or website to learn how to take photos with your new digital camera. You would like to have:

a. A chance to ask questions and talk about the camera and its features.
b. Clear written instructions with lists and bullet points about what to do.
c. Diagrams showing the camera and what each part does.
d. Many examples of good and poor photos and how to improve them.

43. Do you prefer a teacher or a presenter who uses:

a. Demonstrations, models or practical sessions.
b. Question and answer, talk, group discussion, or guest speakers.
c. Handouts, books, or readings.
d. Diagrams, charts or graphs.

44. You have finished a competition or test and would like some feedback. You would like to have feedback:

a. Using examples from what you have done.
b. Using a written description of your results.
c. From somebody who talks it through with you.
d. Using graphs showing what you had achieved.

45. You are going to choose food at a restaurant or cafe. You would:

a. Choose something that you have had there before.
b. Listen to the waiter or ask friends to recommend choices.
c. Choose from the descriptions in the menu.
d. Look at what others are eating or look at pictures of each dish.

46. You have to make an important speech at a conference or special occasion. You would:

a. Make diagrams or get graphs to help explain things.
b. Write a few key words and practice saying your speech over and over.
c. Write out your speech and learn from reading it over several times.
d. Gather many examples and stories to make the talk real and practical.

For questions 47 through 53, please circle the appropriate response and/or provide comments as necessary.

47. During performance progress checks, did anything affect your ability to observe schematics on the laptop computer? (If yes, please explain)

a. Yes
b. No

Comments:

48. Generally speaking, you are:

a. A slow learner
b. A fast learner

49. Where appropriate, would it have been useful to have a wire signal and tracing tool in other blocks of instruction?

a. Yes
b. No

Comments:

50. What did the instructor do that was helpful in your learning of the material?

51. What could the instructor have done better to teach you the material?

52. How many hours (or minutes) did you spend outside the classroom studying the Global Deicer schematic diagrams?

53. Do you think you would have learned better if the class was more interactive, that is if the teacher engaged the students more often?

a. Yes
b. No
c. Unsure

Comments:

For questions 54 through 57, circle the number that corresponds to your level of agreement or disagreement.

Strongly Disagree						Strongly Agree
1	2	3	4	5	6	7

54. The wiring and signal tracing tool made it easier for me to learn the schematics.

1 2 3 4 5 6 7

55. I fell behind during the class because everything was going so fast.

1 2 3 4 5 6 7

56. I prefer to write things out as opposed to seeing things happen.

1 2 3 4 5 6 7

57. I learn better by touching/hands-on exercises than by watching events happen.

1 2 3 4 5 6 7

LIST OF ACRONYMS

AF	Air Force
AFQT	Armed Forces Qualification Test
ANOVA	Analysis of Variance
ASVAB	Armed Services Vocational Aptitude
TFD	Tools for Decision
USAF	United States Air Force
VARK	Visual, Auditory, Read/Write, and Kinesthetic